MSIAC
Munitions Safety Information Analysis Center

How Nations Apply TNT Equivalency in QD Frameworks: Balancing Simplicity and Scientific Accuracy

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Common Questions

- Why is TNT equivalence relevant to Quantity-Distance (QD) assessments?
- For QD purposes, is TNT equivalence applicable only to Hazard Division 1.1, or should it also be used for other Hazard Divisions?
- Is there a TNT equivalence table in AASTP-1? I seem to recall seeing one, but I have been unable to locate it.
- Does the NEQ value already reflect TNT-equivalent mass adjustments?
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TNT equivalence and QDs

AASTP-1 (Ed. D, Ver. 1)

QD distances provided in this document for HD 1.1 are based on TNT-equivalencies for the energetic materials that are involved. Significant differences in the TNT equivalency must be considered.

Applications during storage of explosives and ammunitions (AE)

Raw / Bulk HD 1.1 Explosives (Not TNT)	Assembled Munition Systems	Mixed Hazard Division Storage including HD 1.1
C4 ($TNT_{eq} \approx 1.19 – 1.37$)	High explosive component (if not TNT)	Aggregated HD 1.1 NEQ approach
PETN ($TNT_{eq} \approx 1.27$)	Propellants / Rocket Motors	$NEQ = TNT_{eq,1}NEQ_{1.1} + TNT_{eq,3}NEQ_{1.3}$

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TNT equivalence for other HDs

HD / SsD	Definition
HD 1.1	Substances and articles which have a mass explosion hazard.
SsD 1.2.1	Substances and articles which have a projection hazard but not a mass explosion hazard.
SsD 1.2.2	
SsD 1.2.3	
SsD 1.3.1	Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.
SsD 1.3.2	
HD 1.4	Substances and articles which present no significant hazard
HD 1.5	Very insensitive substances which have a mass explosion hazard.
HD 1.6	Extremely insensitive articles which do not have a mass explosion hazard.

QD criteria are based on trials involving TNT (or other HD 1.1 AE that were adjusted to TNT-equivalent weights).

QD criteria are based on trials involving AE of the relevant HD, **without applying TNT-equivalent adjustments**.

TNT Equivalence may be relevant for these HDs when applying an aggregated HD 1.1 NEQ approach (e.g., munition systems / mixed storage).

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TNT equivalence table in AASTP-1

AASTP-1 / Edition 1 (1992)
Part II / Chapter 5: Design Environment Criteria

Chapter 5 has been removed since
AASTP-1 / Edition B, Version 1 (2015)

MATERIAL	PEAK PRESSURE (TNT)	IMPULSE (TNT)
TNT	1.00	1.00
EXPLOSIVE D	0.85	0.81
CYCLOTOL 70/30	1.14	1.09
RDX/5 WAX	1.19	1.16
COMP B	1.13	1.06
COMP A-3	1.09	1.07
PICRATOL	0.90	0.93
MINOL II	1.24	1.22
TRITONAL 80/20	1.07	1.11
HBX-1	1.21	1.21
TORPEX II	1.23	1.28
H-6	1.27	1.38
PENTOLITE	1.16	1.15
HBX-3	1.16	1.25
TNETB	1.13	0.96
RDX/WAX 98/2	1.19	1.16
COMP B/TiH_2 70/30	1.13	1.13

- Introduction of new Risk Analysis Manual (AASTP-4)
- Information now contained in AASTP-4 manual with 3 options for calculating average equivalency relative to TNT:
  - Measured Equivalencies: **TNT Equivalence Table** (Option 1)
  - Estimated Equivalencies: **Heats of Detonation** (Option 2)
  - Conservative Estimate: **Factor of 1.4** (Option 3)
- The AASTP-4 manual contains the current explosion effect models and is regularly updated. Users should refer to this manual when an explosion effect model is needed for QD purposes (or for risk analyses).

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NEQ value and TNT Equivalency

Current edition, promulgated in June 2026

Net Explosive Quantity (NEQ) definition in **NATOTerm** (*same definition in AASTP-3, Ed. B, Ver. 1*):

The mass expressed in kilograms of all materials that will contribute to the magnitude of an explosive event, where applicable expressed as an equivalent mass of TNT.

Net Explosive Quantity (NEQ) definition in **AASTP-1 (Ed. D, Ver. 1)** (*same definition in AASTP-3, Ed. 1, Ch. 3*):

The NEQ of a single munition is the total explosive contents (NEM) of the munition unless it has been determined (e.g. by testing) that the explosive effects of the munition significantly differ from the explosive effects expected from that quantity (e.g. the effects not contribution from a rocket motor in an all-up missile).

Discussed in latest meeting of AC/326 SG/C ➔ To avoid confusion, proposal to remove NEQ definition from AASTP-1 (as this is defined in NATOTerm)

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  Yes (if applicable), but to what extent is this approach implemented by the Nations in practice?

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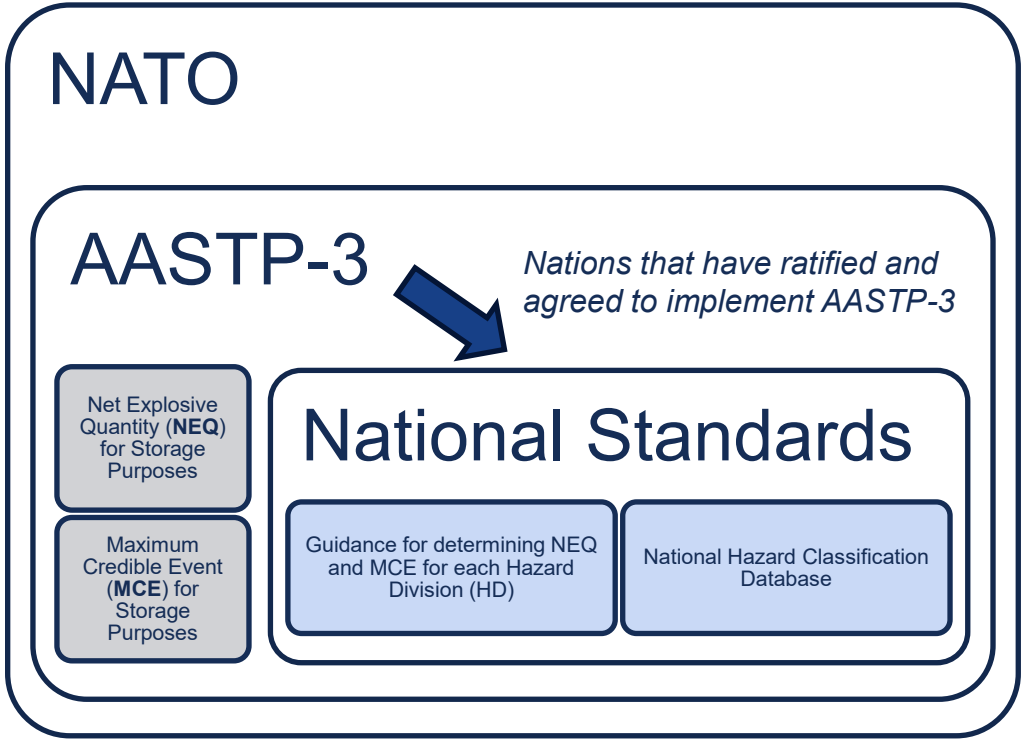
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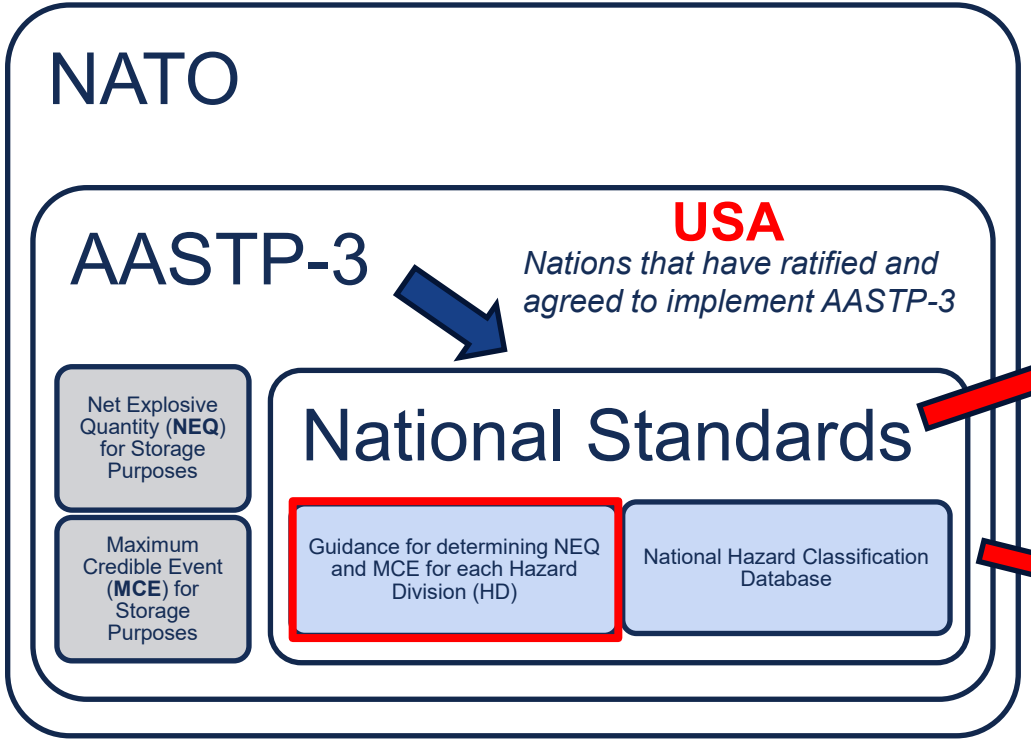
Hazard Classification vs QD

Hazard Classification



Hazard Classification vs QD

Hazard Classification



DESR 6055.09

Guidance for calculating the net explosive weight for quantity-distance (NEWQD) by hazard division

Joint Hazard Classification System (JHCS)

Provides NEWQD values for all DoD hazard classified AE.

Hazard Classification vs QD

Hazard Classification → Quantity Distances

NATO

AASTP-3

- Net Explosive Quantity (**NEQ**) for Storage Purposes
- Maximum Credible Event (**MCE**) for Storage Purposes

→ Quantity Distance Tables

NEQ values should reflect TNT-equivalent mass adjustments, if applicable!

NATO

AASTP-1

Hazard Divisions

Explosion Effects (Max QD)	HD1.1	SsD1.2.1	SsD1.2.2	SsD1.2.3	SsD1.3.1	SsD1.3.2	HD1.6
BLAST	NEQ	MCE		MCE			MCE
DEBRIS & FRAG	NEQ	MCE		MCE			MCE
PROG' 1.2.1		NEQ					
PROG' 1.2.2			NEQ				
THERMAL 1.3.1					NEQ		
THERMAL 1.3.2				NEQ		NEQ	NEQ

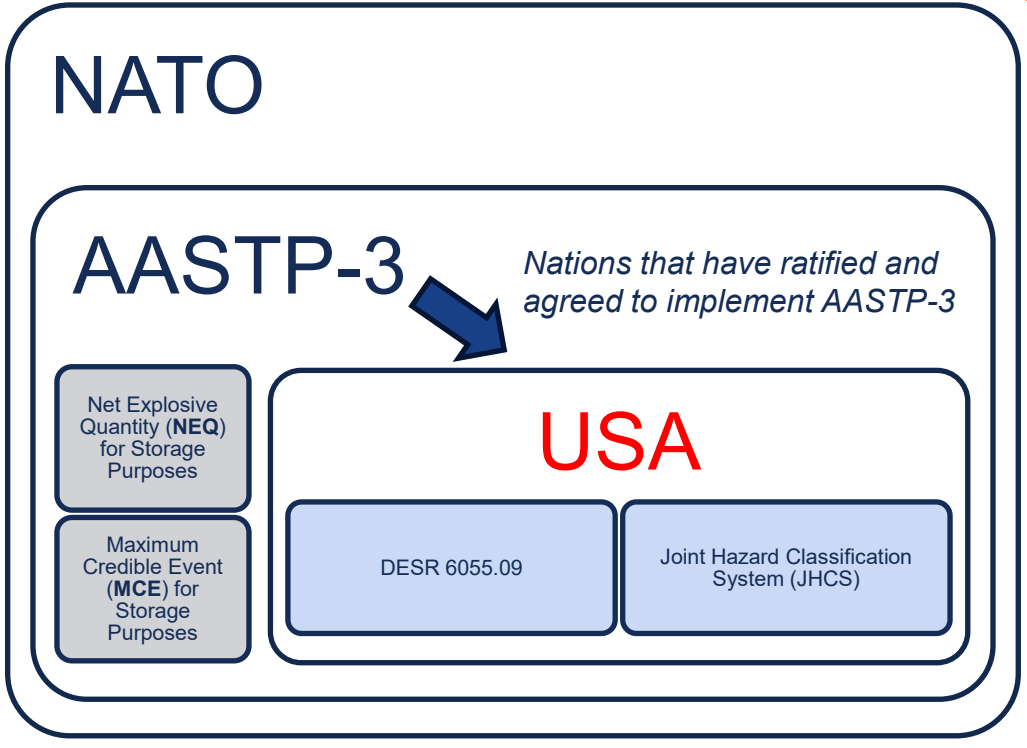
National Approaches

Nation	National Standard	National Hazard Classification Database	*TNT Equivalence included in NEQ?	TNT Equivalence considered for QD?
USA	DESR 6055.09	Yes	No	No
Canada	C-09-005-002/TS-001	Yes	No *(only for aggregation purposes)*	No
UK	DSA 03.OME Part 2	Yes	TBC	TBC
Australia	DEOP 101	Yes	TBC	TBC
Netherlands	MP 40-21	Yes	No *(only for foreign articles that already include TNT equivalence)*	No *(specific provisions only for IBD and naval criteria.)*

USA

No TNT equivalence!

Hazard Classification



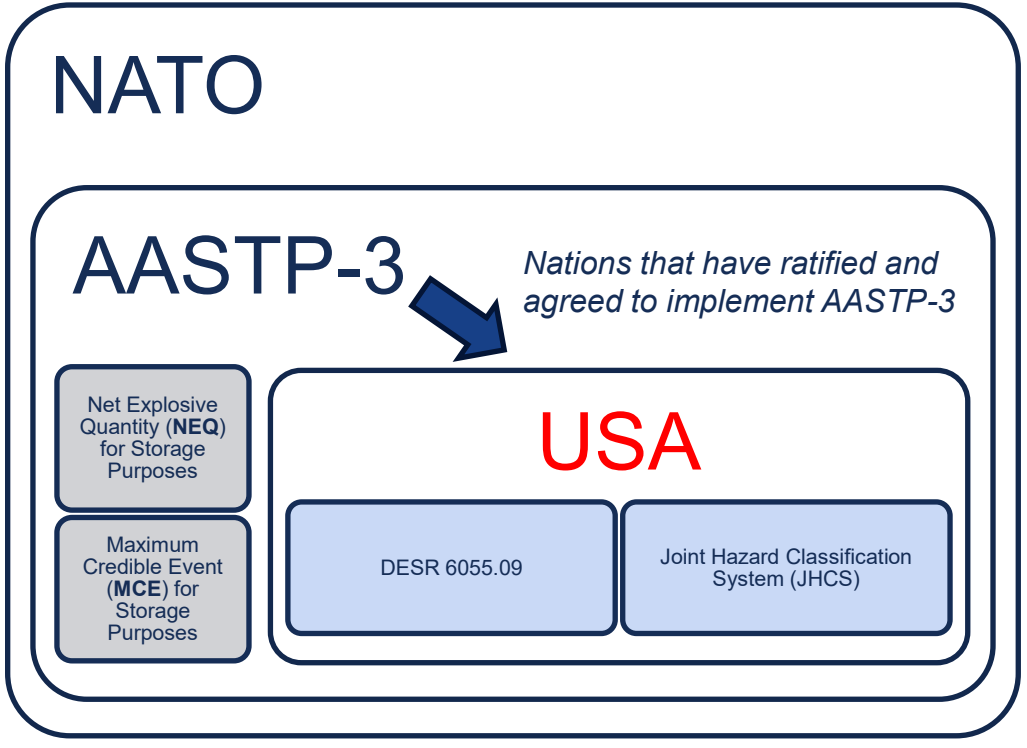
NEQ ➔ NEWQD
Net explosive weight for quantity-distance

HD	NEWQD	Notes
1.1	HEW + NPW	NEWQD = NEW
1.2.1	HEW + NPW or MCE	or MCE
1.2.2	HEW + NPW	
1.2.3	HEW + NPW	or MCE for minimum IBD
1.3	HEW + NPW + total weight of pyrotechnics	NEWQD = NEW
1.4	HEW + NPW + total weight of pyrotechnics	NEWQD = NEW
1.5	HEW + NPW	NEWQD = NEW
1.6	EIDS	or MCE for hazard zones

HEW: Total High Explosive Weight; NEW: Net Explosive Weight
NPW: Total Net Propellant Weight; EIDS: extremely insensitive detonating substances

USA

Hazard Classification



Illustrative Worst-Case Example: Storage of Pure C4 Explosive

- Hypothetical scenario: an entire storage building contains only bulk Composition C4 explosive.
- Composition C4 exhibits a TNT equivalence factor greater than 1.0, meaning it can produce blast effects exceeding those of an equal mass of TNT. A typical TNT-equivalence factor used for blast calculations is approximately 1.2-1.4 (Reference: AASTP-4).
- Under DESR 6055.09, QD calculations for HD 1.1 are based on NEW only (NEWQD = NEW). However, for this hypothetical example, a TNT-equivalent approach would result in:

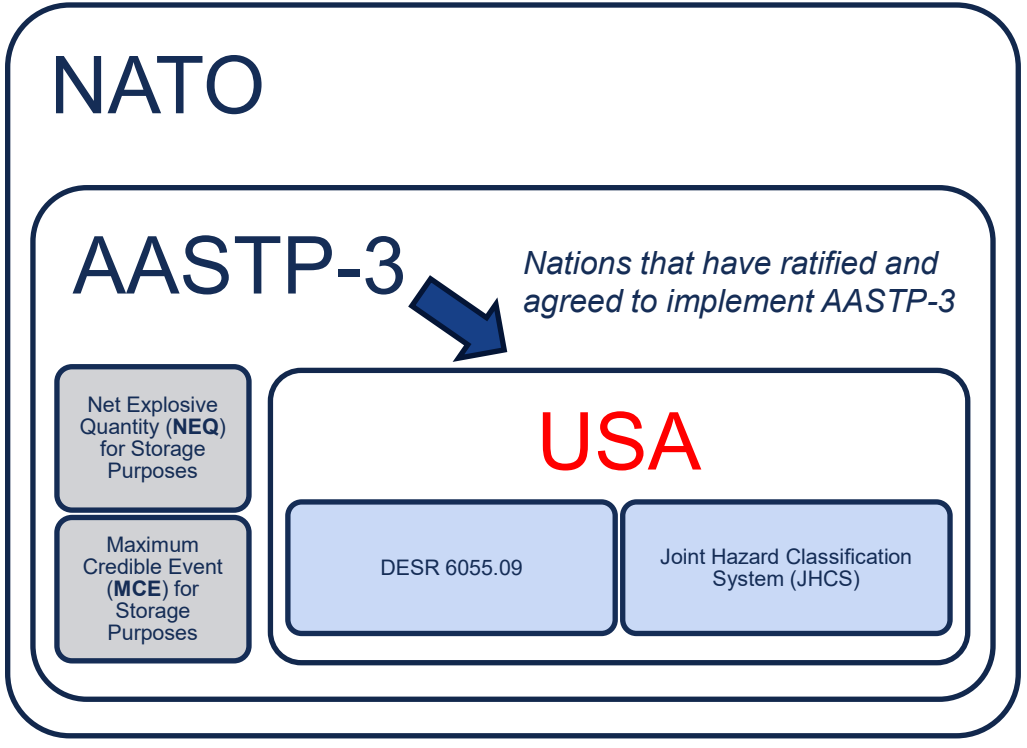
$$\text{NEWQD} = \text{TNT Equivalency Factor} \times \text{NEW}$$

$$\text{NEWQD} \approx 1.4 \times \text{NEW}$$

Therefore, using NEW alone would underestimate the TNT-equivalent explosive effects by approximately 40% in this extreme scenario!

USA

Hazard Classification

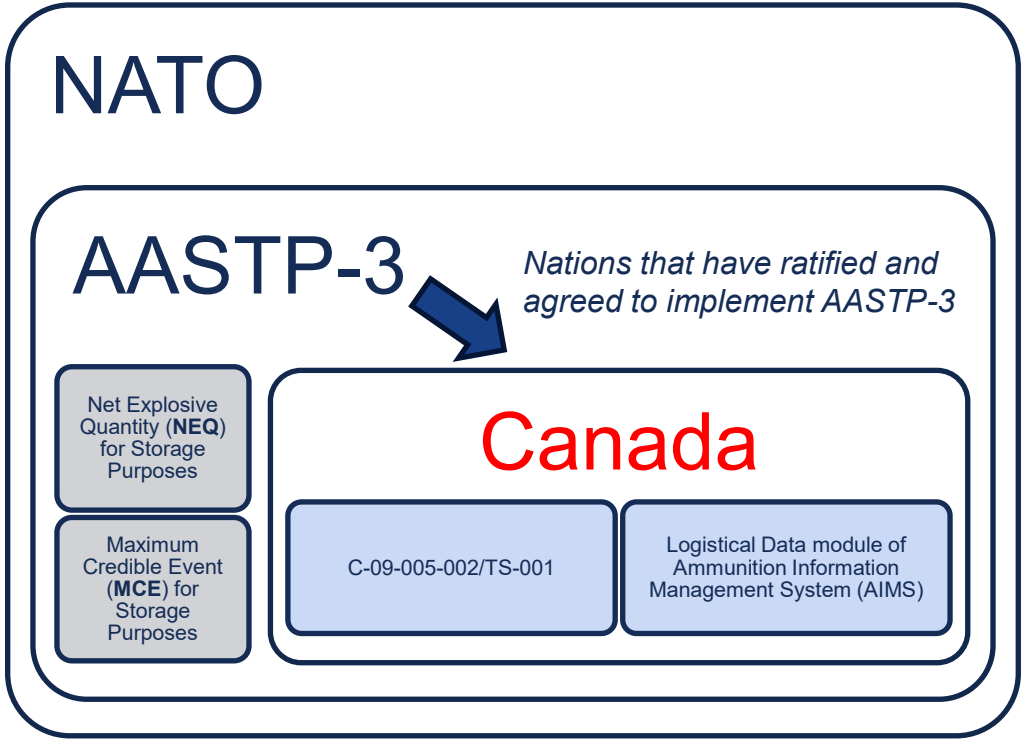


Rationale for Retaining NEWQD = NEW

- Practicality and proportionality underpin the approach. Just as QD assessments do not re-evaluate magazine geometry, construction details (reinforcement, concrete grade), ground conditions, and other parameters for every facility, TNT-equivalence methods are applied using a pragmatic and proportionate level of effort.
- Pure C4 storage is an exceptional case. Operational storage facilities rarely contain exclusively bulk Composition C4 explosive.
- Conservative Assumption 1: QD calculations normally assume the entire authorised NEQ (or NEWQD) is present, whereas actual stored quantities are often significantly lower.
- Conservative Assumption 2: QD methodology generally assumes full explosive involvement and complete mass detonation, whereas real events are unlikely to achieve 100% participation of all explosive material.

Canada

Hazard Classification



- NEQs are provided in the Logistical Data module of the Ammunition Information Management System (AIMS).
- C-09-005-002/TS-001 highlights that for HD 1.1 AE significant differences in the TNT equivalency must be considered when applying QDs.

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USA Approach ➔ Explicitly states that TNT equivalency is not considered (for HD 1.1 NEWQD = NEW)

- In practice, no TNT equivalency adjustment is applied, as in most cases it is not physically feasible to load a magazine to its licensed NEQ capacity with HD 1.1 explosives.

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USA Approach ➔ TNT equivalency not applied in QD assessments!

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Future efforts will focus on completing this table. Discussions have already commenced with France and Germany, with engagement of additional Nations planned.

Closing Remarks

AC/258-UK(ST)-IWP/195

*It has been argued at the *NATO AC/258 Storage Group Meetings during the period **1984-1987** that the TNT equivalence of the NEQ should be calculated and used to determine the quantity distance. The merits of this approach are currently under consideration within the NATO AC 258 Group. Whilst there is general agreement that **ideally** the TNT equivalence should be used, it is also acknowledged that there are a number of other factors that could affect the TNT equivalence, i.e., charge shape, loading density, charge weight ratio etc.*

*Predecessor to the current AC/326 SG/C group